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By THOMAS E. BOWMAN *and* JUAN G. GONZÁLEZ

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FOUR NEW SPECIES OF PSEUDOCYCLOPS (COPEPODA: CALANOIDA) FROM PUERTO RICO

By Thomas E. Bowman and Juan G. González[1]

The vast majority of marine calanoid copepods are planktonic in habit, but a few, referred to as benthic or bottom-living forms, have been collected almost exclusively on or near the bottom. Although these forms are contained in several not closely related families, they have in common small size, plump body, short antenna 1, and strong outer spines on the exopods of the swimming legs.

The bottom-living genus *Pseudocyclops*, the sole genus in the family Pseudocyclopidae, contains 9 species and 1 subspecies. Since *Pseudocyclops* is rarely taken by the usual collecting methods, it is probable that the vast majority of the species of this genus are as yet undescribed. The fact that we have collected 4 new species from a single locality, doubling the number of known Atlantic species, lends support to this belief. These 4 species we describe below, following our diagnosis of *Pseudocyclops* and our observations on the behavior and the ecological niche of its members.

The detection of a very few specimens of *Pseudocyclops* in plankton tows led to a search for its habitat. Most of the specimens had been collected in the Canal de Magüeyes, the shallow channel between

[1] The former is associated with the U.S. National Museum, the latter with the Institute of Marine Biology, University of Puerto Rico, Mayagüez.

567159—61——1

Magüeyes Island and the mainland near La Parguera, Puerto Rico, where the bottom is covered with turtle grass, *Thalassia testudinum*, and the associated algae, *Penicillus capitatus*, *Halimeda opuntia*, and *Dictyota cervicornis*. Since we suspected that *Pseudocyclops* lived close to or on the bottom, we made collections with No. 10 and No. 20 mesh nets, 1 foot in diameter, the nets towed close to the bottom so that they passed through the *Thalassia* leaves. The nets were towed either by hand while swimming, or from behind a boat; in the latter case the nets were held at the desired depth by a swimmer alongside them. Large numbers of *Pseudocyclops* were obtained by this method.

Family Pseudocyclopidae Giesbrecht, 1893

Since the relationships of the family are still uncertain, we have refrained from giving a family diagnosis.

Genus *Pseudocyclops* Brady, 1872

Pseudocyclops Brady, 1872, p. 431. Type species, by monotypy, *P. crassiremis* Brady, 1872; gender masculine.

The emended diagnosis given below is based on the characters of the 4 new Puerto Rican species and the 10 previously described species. Since some of the latter species are incompletely described or known from only one sex, and many species, perhaps a majority, have not yet been discovered, the diagnosis must be considered provisional. In particular *Pseudocyclops simplex* Sewell (1932) differs from this diagnosis in its swimming leg setation and should be given further study. We follow Gooding's (1957) usage of terms for regions of the copepod body.

Diagnosis (emended): Body plump; head separated from or fused with first pedigerous segment; fifth pedigerous segment small. Urosome 4-segmented in female, 5-segmented in male; genital segment not much produced ventrally; genital openings widely separated in female, male genital opening on left side; anal segment very short, immersed in and almost completely concealed by preceding segment. Outermost caudal seta spiniform; next-to-innermost seta longer and thicker than others. Rostrum single, strongly developed, without filaments, sometimes movable in male. Antenna 1 very short, scarcely reaching beyond head, 14–18 segmented, first segment bearing 3 long sensory filaments (aesthetes); right antenna 1 of male geniculate. Exopod of antenna 2 with reduced number of segments. Endopod of maxilla 1 elongate, setae of outer lobe reduced. Endopod of maxilliped short, indistinctly segmented.

Legs 1–4 with 3-segmented rami; outer spines of exopods robust; inner setae jointed near the middle, moderately thick proximal to

joint, slender and plumose distal to joint. Exopod segments 1 and 2 with 1 inner seta and 1 outer seta; segment 3 with 1 terminal seta, 2–2–3–3 inner setae, and 4–5–5–5 outer setae; endopod segment 3 with 6–8–8–7 setae on legs 1–4 respectively. Female leg 5 with 3-segmented exopod and endopod of 1–3 segments; exopod segment 3 with 3 outer setae, distal one apparently terminal, and terminal seta inserted slightly medial to apex and often curving medially; inner setae often reduced in number or absent.

Leg 5 of male forming a complex grasping organ. Right exopod unisegmental, bearing a short flanged outer spine and 2 long spines curving inward; right endopod unisegmental, unarmed. Left exopod 2-segmented; proximal segment bearing a flanged spine, distal segment bearing membranous appendages; left endopod unisegmental, often bearing several plumose setae at the apex; a slender elongate appendage arises from left second basipod adjacent to endopod.

Key: The four new Puerto Rican species described below can be distinguished by the key below. Our key is purposely based on characters that can be observed without dissection, but it may be necessary to examine cleared specimens with a compound microscope. Since the genus *Pseudocalanus* appears to be highly endemic, the key is reliable only in the vicinity of the type locality and should be used with caution elsewhere:

1. Head and first pedigerous segment fused 2
   Head and first pedigerous segment not fused 3
2. Rostrum very large; second pedigerous segment produced into process ventrolaterally; caudal setae with barbs . . . . . **rostratus**
   Rostrum of moderate size; second pedigerous segment rounded ventrolaterally; caudal setae without barbs . . . . . **cokeri**
3. Length 0.50–0.62 mm.; prosome with red band, or sometimes all red; male rostrum articulated at base; endopod of female leg 5 3-segmented. **rubrocinctus**
   Length 0.37–0.43 mm.; body colorless; male rostrum not articulated at base; endopod of female leg 5 unisegmental . . . . . **paulus**

Relative abundance: In one tow through the turtle grass, all the specimens of *Pseudocyclops* obtained in the sample were enumerated as to species and sex with the following result:

Species	Female	Male
cokeri	321	154
rubrocinctus	63	3
paulus	44	8
rostratus	0	0

P. rostratus is quite rare in all our collections. It is possible that our method of collection does not sample the main habitat of *P. rostratus* but only collects a few individuals on the periphery.

Ecological niche: We have observed the behavior of living specimens of the species of *Pseudocyclops* described below, with the

exception of *P. paulus*, in the laboratory. *Pseudocyclops* spends most of its time swimming among the algal filaments attached to the *Thalassia* leaves with a smooth leisurely motion that gives it the appearance of gliding slowly through the water. The first antennae are held closely against the body, directed upward at an angle of about 45°, and the swimming legs are bent forward and held motionless against the ventral surface. The urosome is usually bent slightly ventrally, but turns to one side when the animal changes direction. The gliding movement is brought about by rapid vibratory movements of the second antennae and mandibular palps, especially the former. We were unable to observe the first maxillae in living specimens, but the second maxillae do not vibrate and are held in position to filter food particles brought to it.

In addition to the leisurely gliding motion, *Pseudocyclops* can also make very quick movements of about 2 to 4 times the body length, with a flip of the swimming legs. These movements, made to avoid a needle or forceps, are always in a forward direction. Longer avoidance movements probably involve several consecutive flips of the swimming legs, but we were unable to follow the motion of the legs during these movements.

Pseudocyclops occasionally alights on algal filaments, but does not walk along their surfaces as do the harpacticoid copepods. The large outer spines on the exopods of the swimming legs must enable *Pseudocyclops* to hold tightly to the substrate; it is very difficult to pick up living specimens with an eyedropper.

The observations of Giesbrecht (1893) on the swimming of *Pseudocyclops umbraticus* and those reported by Noodt (1958) for *P. gohari*, although less detailed, are in essential agreement with ours.

Our observations make it possible to characterize the ecological niche of *Pseudocyclops*. It lives in the interstices of the filamentous algae attached to the lower parts of the *Thalassia* leaves, where it feeds by filtering the water through which it swims. The small size, compact body, and short antennae enable it to maneuver in restricted spaces too small for other calanoid copepods. It competes neither with the planktonic calanoids in the open water above the *Thalassia* leaves nor with the abundant harpacticoids, which feed by browzing on the algal surfaces rather than by filtering the water.

The presence of 4 congeneric species in the same habitat is of considerable interest and raises the question of competition among them. Hutchinson (1951) has pointed out that when 2 freshwater calanoids coexist in the same habitat, they usually differ in size. He suggested that differences in the type of food utilized should accompany these size differences and reduce or eliminate competition

for food. In support of Hutchinson's suggestion, Fryer (1954) found clear-cut differences in the gut contents of *Diaptomus laticeps* and the smaller *D. gracilis* in Lake Windermere, England. It is possible that differences in food preference may enable the 4 species of *Pseudocyclops* to live together without undue competition. A ciliate protozoan abundant among the *Thalassia* leaves in the Canal de Magüeyes could often be seen in the guts of cleared specimens of *P. cokeri*, but was only rarely observed in the other 3 species.

Pseudocyclops cokeri, new species

FIGURES 1–3

FEMALE: Length, excluding caudal setae, 0.5–0.6 mm. Prosome stout; width, viewed dorsally, slightly more than half the length. Head fused with first pedigerous segment except in ventrolateral region, where partial suture is present. Rostrum prominent, but not so strongly developed as in other Puerto Rican species.

Urosome about three-eighths as long as prosome in specimens with segments not telescoped. Genital opening with characteristic pattern of sclerotization (fig. 1*d–e*). Behind genital openings is a ring of thickened cuticle from which a membranous sleeve with minutely serrate free (posterior) margin extends backward. Caudal rami about a third longer than wide, without hairs on inner margins. Outer caudal seta subterminal, about as long as ramus; middle 2 of 4 terminal setae with jointed bases; next-to-innermost seta longest, about 3 times as long as urosome, proximal half stout, distal half slender, the seta without barbs, plumose only on distal half of stout portion.

Antenna 1 reaching about half the length of cephalothorax, composed of 15 segments. First segment bearing 3 conspicuous aesthetes about equal ln length to the last 14 segments combined, 1 seta as long as the aesthetes, and several shorter setae. Remaining segments without aesthetes except terminal segment, which bears a single short one; relative lengths and setation of segments as shown in figure 1*f*.

Basipod of antenna 2 consisting of 1 segment partially divided by incomplete suture, without setae. Exopod 2-segmented; proximal segment bearing 5 setae on medial border, 1 in middle of border and 4 distally; distal segment with partial suture near base, bearing 1 medial and 4 distal setae. Endopod 3-segmented; suture between second and third segments weak; setae as shown in figure 2*a*.

Gnathal lobe of mandible only slightly expanded, with 3 strong and 2 small sclerotized teeth, and a nonsclerotized acuminate tooth.

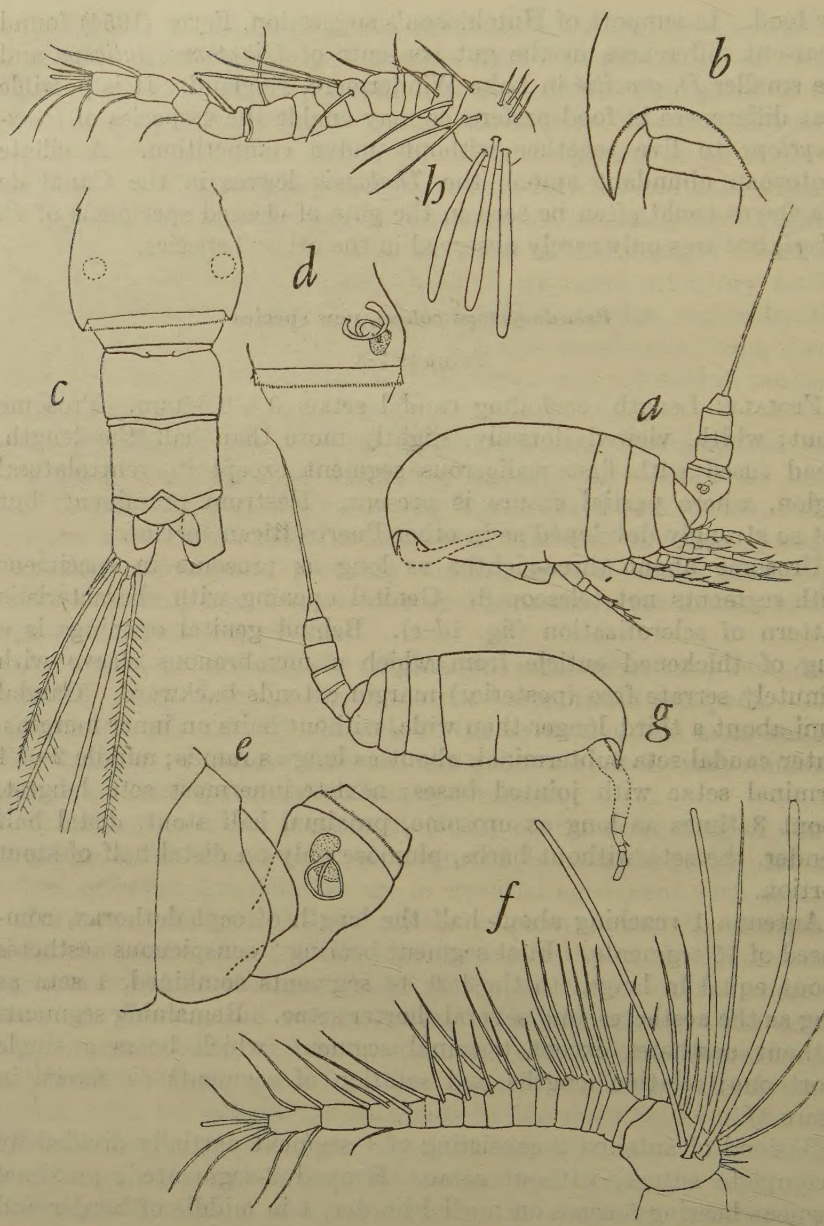

FIGURE 1.—*Pseudocyclops cokeri*, new species. *a–f*, Female: *a*, Lateral; *b*, rostrum, lateral; *c*, urosome, dorsal; *d*, genital segment, ventral, only one genital opening shown; *e*, posterior prosomal segments and genital segment, lateral; *f*, antenna 1. *g–h*, Male: *g*, Lateral; *h*, antenna 1.

FIGURE 2.—*Pseudocyclops cokeri*, new species, female: *a*, Antenna 2; *b*, mandible; *c*, mandible, gnathal lobe; *d*, maxilla 1, setae of first and second inner lobes omitted; *e*, maxilla 1, inner lobes; *f*, maxilliped; *g*, maxilla 2; *h*, leg 1.

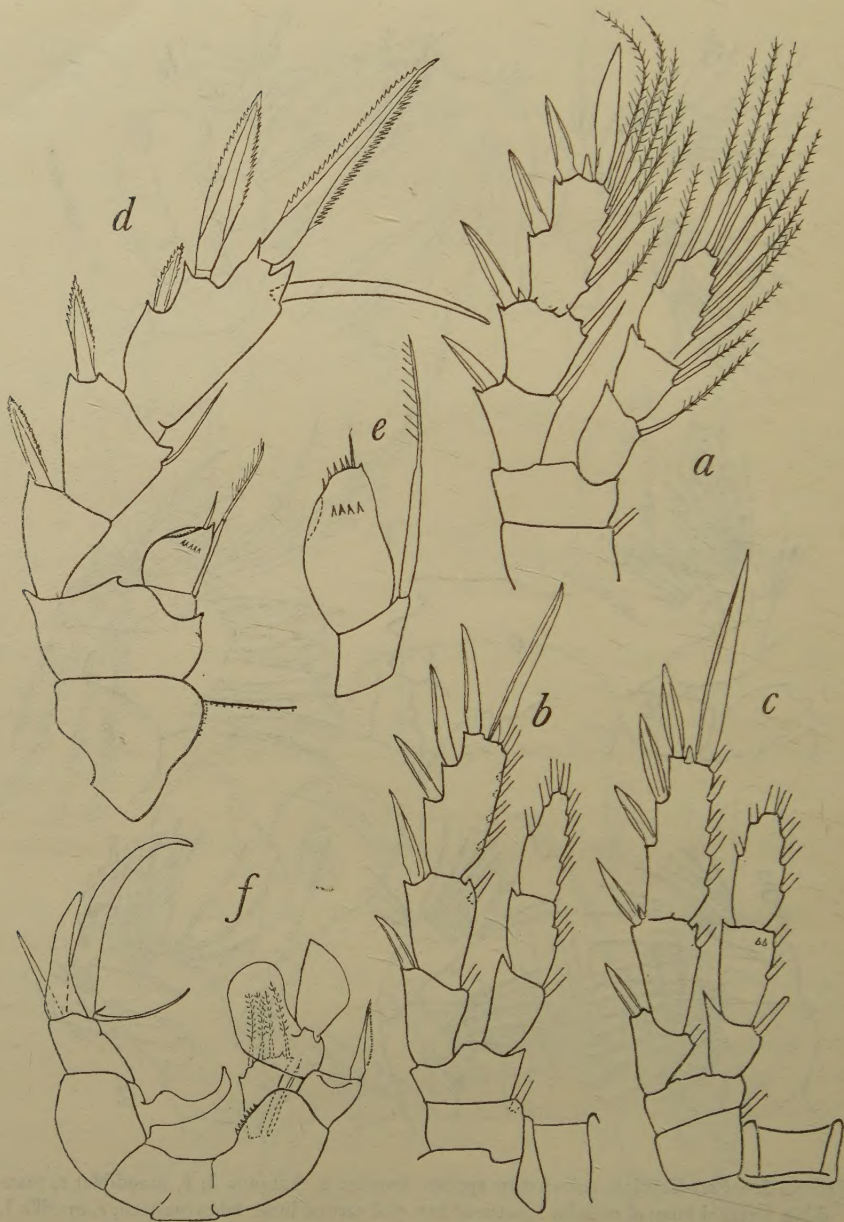

FIGURE 3.—*Pseudocyclops cokeri*, new species: *a*, Leg 2; *b*, leg 3; *c*, leg 4; *d*, leg 5, female; *e*, leg 5, female, endopod, compressed under cover glass; *f*, leg 5, male.

Basipod of palp with 1 inner seta; exopod 3-segmented; endopod 2-segmented; setae as shown in figure 2*b*.

First inner lobe (gnathobase) of maxilla 1 bearing 8 strong spines and 4 subapically placed setae. Second and third inner lobes each bearing 3 setae. First outer lobe (coxal epipod of Gurney) bearing 4 setae increasing in length distally. Exopod with 9 setae. Second basal segment (fourth segment of Gurney) with a group of 3 setae set in a notch near distal end. Endopod not segmented, with 2 groups of 4 setae each on medial margin and 5 terminal setae.

Maxilla 2 with 5 lobes bearing setae as shown in figure 2*g*. Reduced terminal portion indistinctly separated and segmented, with 4 setae.

Maxilliped weakly developed, 3-segmented. First segment with 3 lobes bearing 1, 3, and 2 setae respectively. Second segment produced distally into lobe bearing 1 seta at base and 2 at apex. Third segment indistinctly divided, bearing 6 setae on anterior margin and 3 on posterior margin.

Legs 1–4 without surface spinules except for pair near inner margin on distal part of endopod segment 2 of leg 4. Proximal outer seta of exopod segment 3 of leg 1 (in specimen illustrated) longer and heavier than distal outer seta (in other specimens examined the 2 setae were subequal); distal seta without flange, with finely serrate margins.

Connecting piece of leg 5 with nearly straight distal margin. Basipod segments without inner setae. Second basipod with single spinule on posterior surface; distal margin armed with spinules. Exopod segment 3 without inner setae. Endopod 2-segmented; proximal segment with inner seta; distal segment subpyriform, distal margin produced into tooth medially and bearing a slender seta adjacent to tooth and a series of spiniform setae, posterior surface armed with a row of spinules.

Male: Length 0.45–0.55 mm. Habitus as in female. Prosome nearly 2.5 times as long as urosome. Rostrum not articulated at base. Segments 1 and 2 of urosome with minutely serrate rings near posterior margins. Caudal setae as in female.

Left antenna 1 as in female, but aesthetes on first segment much more robust. Right antenna 1 with 15 segments, geniculate between segments 11 and 12, segment 12 with heavy spine, aesthetes on first segment as in left antenna 1.

Basipod of right leg 5 stout, surface unarmed or with a few spinules. Exopod unisegmental, about a third longer than broad, armed distally with 1 slender and 2 stout spines, the inner stout spine much the longest, curved medially at distal end, bearing a seta at its base. Endopod hook shaped, thickened at base. Left basipod with a

567159—61——2

row of surface spinules. Exopod about as long as broad, bearing a flanged seta on outer distal margin and on distal inner margin an ensiform membranous lobe to which is attached laterally a subpyriform membranous lobe. Endopod narrow at base, broader distally, bearing 4-jointed setae on distal margin. Adjacent to base of endopod a slender stiff seta as long as endopod arises from basipod.

Color: Body without pigmentation except for the orange-red eye.

Types: Holotype, female, USNM 104386; allotype, male, USNM 104387; and 475 paratypes (321 females, 154 males) from *Thalassia* meadow, Canal de Magüeyes, La Parguera, Puerto Rico, collected Feb. 26, 1959 (holotype and allotype), and Feb. 23, 1959 (paratypes).

This species is named in honor of Dr. Robert E. Coker, Emeritus Kenan Professor of Zoology, University of North Carolina, and Consultant, Institute of Marine Biology, University of Puerto Rico, in recognition of his many studies on copepods and in gratitude for his advice and encouragement during the course of the present study.

The fusion of the head and first pedigerous segment, the absence of barbs from the caudal setae and near absence of surface spinules from the legs, and the structure of the fifth legs of both sexes serve to identify this abundant species.

Pseudocyclops paulus, new species

Figures 4–5

Female: Length 0.40–0.42 mm. Prosome, viewed dorsally, slightly more than twice as long as wide. Head in lateral view more convex anteriorly than in other Puerto Rican species of *Pseudocyclops*, separated from first pedigerous segment by weak suture. Rostrum very strong, curved slightly posteriorly. Third pedigerous segment with median sclerotization extending forward from middle of posterior margin. Genital segment only slightly produced ventrally; genital openings almost lateral; with sclerotization pattern similar to that of *P. cokeri*.

Urosome about three-tenths as long as prosome; serrations on posterior margins of segments well developed, coarsest in third segment, especially in dorsal part. Caudal rami about a half longer than wide, without hairs on inner margin. Middle 2 of 4 terminal setae much longer and thicker than others. Next-to-innermost seta about 2.5 times as long as urosome; distal half plumose; basal half armed with barbs, 2 on lateral margin and 4–5 on medial margin. Second-from-innermost seta shorter and thinner but with similar armature.

Antenna 1 16-segmented. Mouth parts with only minor differences from those of *P. cokeri*.

Marginal spines and setae of legs 1–4 as in *P. cokeri*. Proximal outer seta of exopod segment 3 of leg 1 much shorter than distal outer seta. Proximal part of outer margin of exopod segment 3 of leg 1

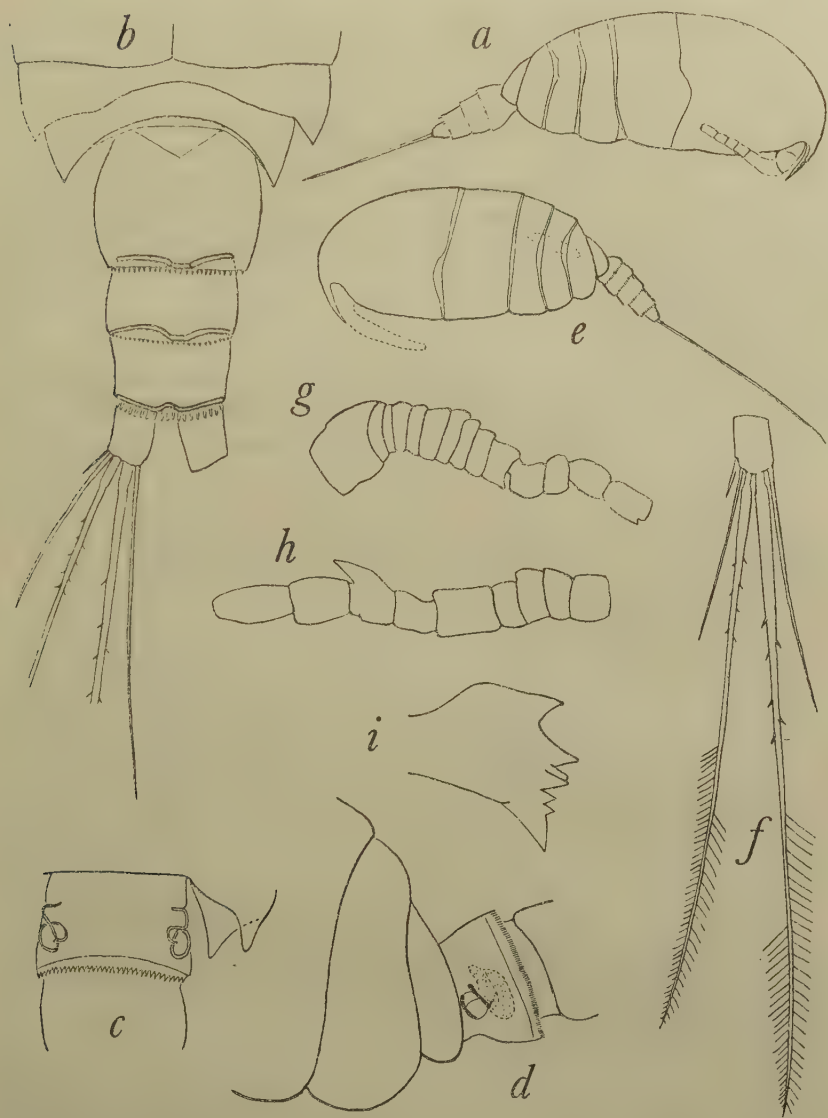

FIGURE 4.—*Pseudocyclops paulus*, new species. *a–d*, Female: *a*, Lateral; *b*, posterior prosomal segments and urosome, dorsal; *c*, genital segment, ventral; *d*, posterior prosomal segments and genital segment, lateral. *e–i*, Male: *e*, Lateral; *f*, caudal ramus and setae, dorsal; *g*, right antenna 1; *h*, right antenna 1, distal segments; *i*, mandible, gnathal lobe.

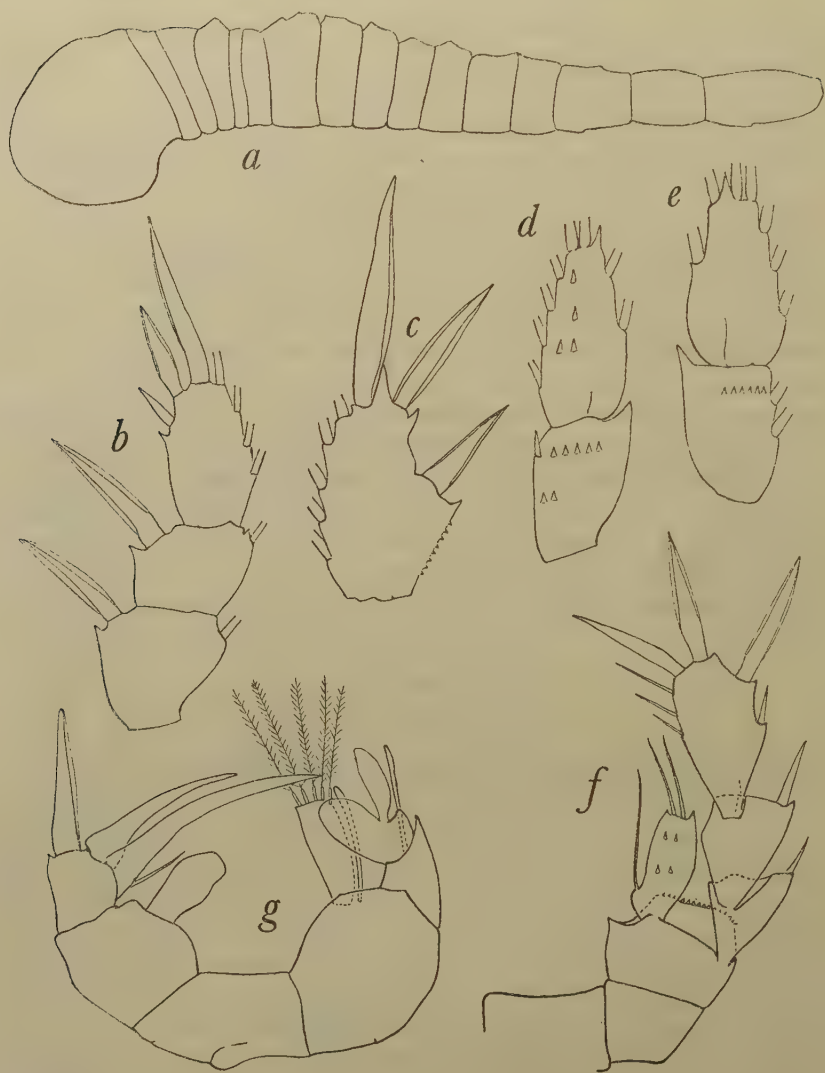

FIGURE 5.—*Pseudocyclops paulus*, new species. *a–f*, Female: *a*, Antenna 1; *b*, leg 1, exopod; *c*, leg 2, exopod segment 3; *d*, leg 3, endopod segments 2–3; *e*, leg 4, endopod segments 2–3; *f*, leg 5. *g*, Male, leg 5.

minutely serrate. Endopods of legs 3 and 4 with surface spinules as shown in figure 5*d–e*.

Exopod segment 3 of leg 5 with 4 outer setae, proximal one much the shorter, moderately long terminal seta, and 2–3 slender, short inner setae. Endopod unisegmental, distal margin bearing 2 slender setae, produced into sharp tooth on either side; medial margin with slender

seta arising from bulge at base; 2–3 rows of surface spinules present, each row with 1–4 spinules.

MALE: Length 0.37–0.43 mm. Habitus as in female. Prosome 3–3.5 times as long as urosome. Rostrum not articulated at base. Posterior margins of urosome segments 1–4 serrate; serrations of segment 4 much coarser than others. Caudal setae as in female. Right antenna 1 with 14 segments; anterior margin of antepenultimate segment produced distally into acute triangular process. Leg 5 with basic plan the same as that of *P. cokeri*. Exopod of right leg with heavier outer distal spine; longer inner spine less curved distally. Endopod a rounded lobe about twice as long as wide. Left basipod without surface spinules. Outer distal seta on left exopod segment 1 linear, without flange, slightly broadened at apex; membranous lobes of segment 2 narrower than in *P. cokeri*. Left endopod bearing 5 jointed setae on distal margin. Seta adjacent to endopod rounded at apex.

COLOR: We did not distinguish *P. paulus* from *P. cokeri* when we we studied live material. Preserved specimens are colorless, and if living specimens have any pigment the species probably would have been detected during the examination of freshly collected material.

TYPES: Holotype, female, USNM 104389; allotype, male, USNM 104390; and 42 paratypes (37 females, 5 males) from *Thalassia* meadow, Canal de Magüeyes, La Parguera, Puerto Rico, collected Feb. 23, 1959.

The specific name *paulus* (Latin "paulus," meaning little) refers to the minute size of this species. It is one of the smallest species of Calanoida yet discovered; only *Pseudocyclopia minor* T. Scott (1892) with a length of 0.43 mm. and *Paracalanus crassirostris* Dahl, the male of which is reported to measure 0.34 mm. (Gurney, 1927), rival it in smallness.

P. paulus is very similar to *P. umbricatus* Giesbrecht (1893), known from the Gulf of Naples and the Suez Canal. *P. umbricatus* is larger (0.60–0.65 mm.); the forehead is less convex; the rostrum is relatively shorter and straighter; the endopod of female leg 5 is 2-segmented, without surface spinules; and the left endopod of the male leg 5 has 4 rather than 5 setae.

***Pseudocyclops rostratus*, new species**

FIGURES 6–8, 9*g*

FEMALE: Length, excluding caudal setae, 0.72–0.76 mm. Prosome, viewed dorsally, slightly more than twice as long as wide. Head fused with first pedigerous segment except in ventrolateral region, where weak partial suture is present. Rostrum huge, curving slightly

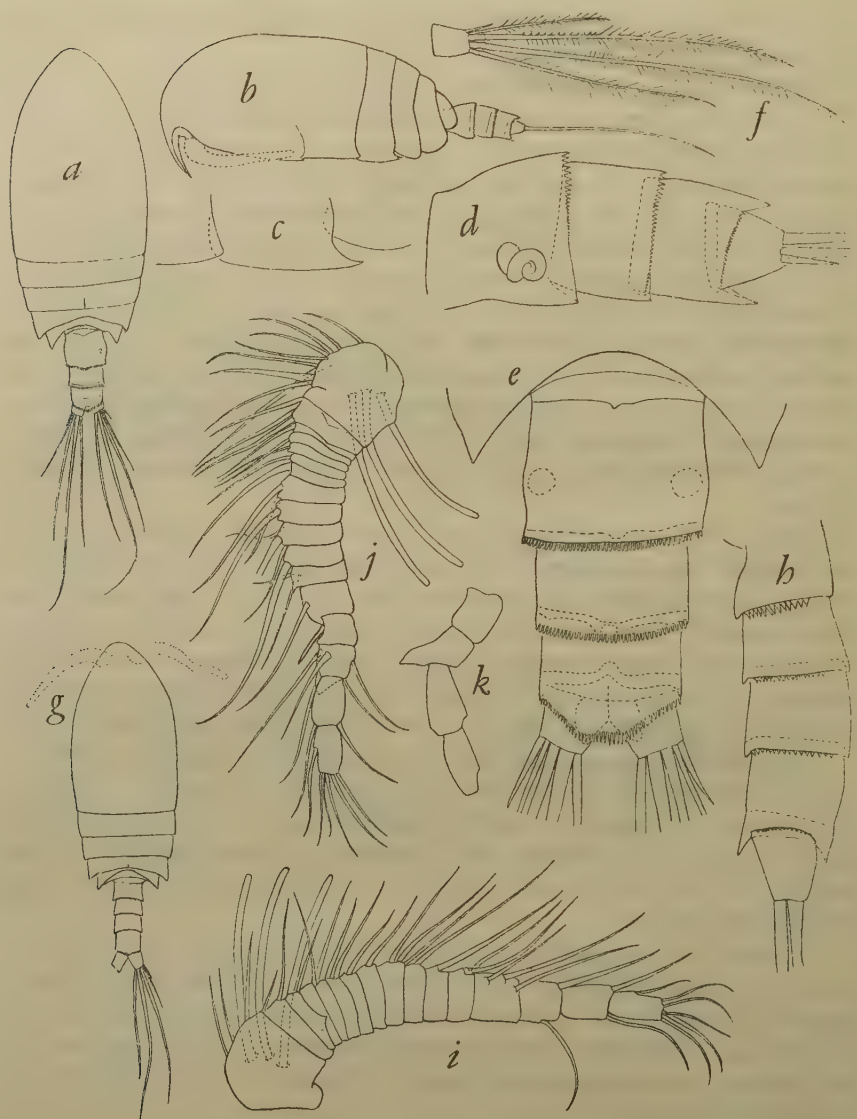

FIGURE 6.—*Pseudocyclops rostratus*, new species. *a–e*, Female: *a*, Dorsal; *b*, lateral; *c*, second pedigerous segment, lateral; *d*, urosome, lateral; *e*, urosome, dorsal. *f–k*, Male: *f*, Caudal ramus and setae, dorsal; *g*, habit, dorsal; *h*, urosome, lateral; *i*, left antenna 1; *j*, right antenna 1; *k*, right antenna 1, distal segments.

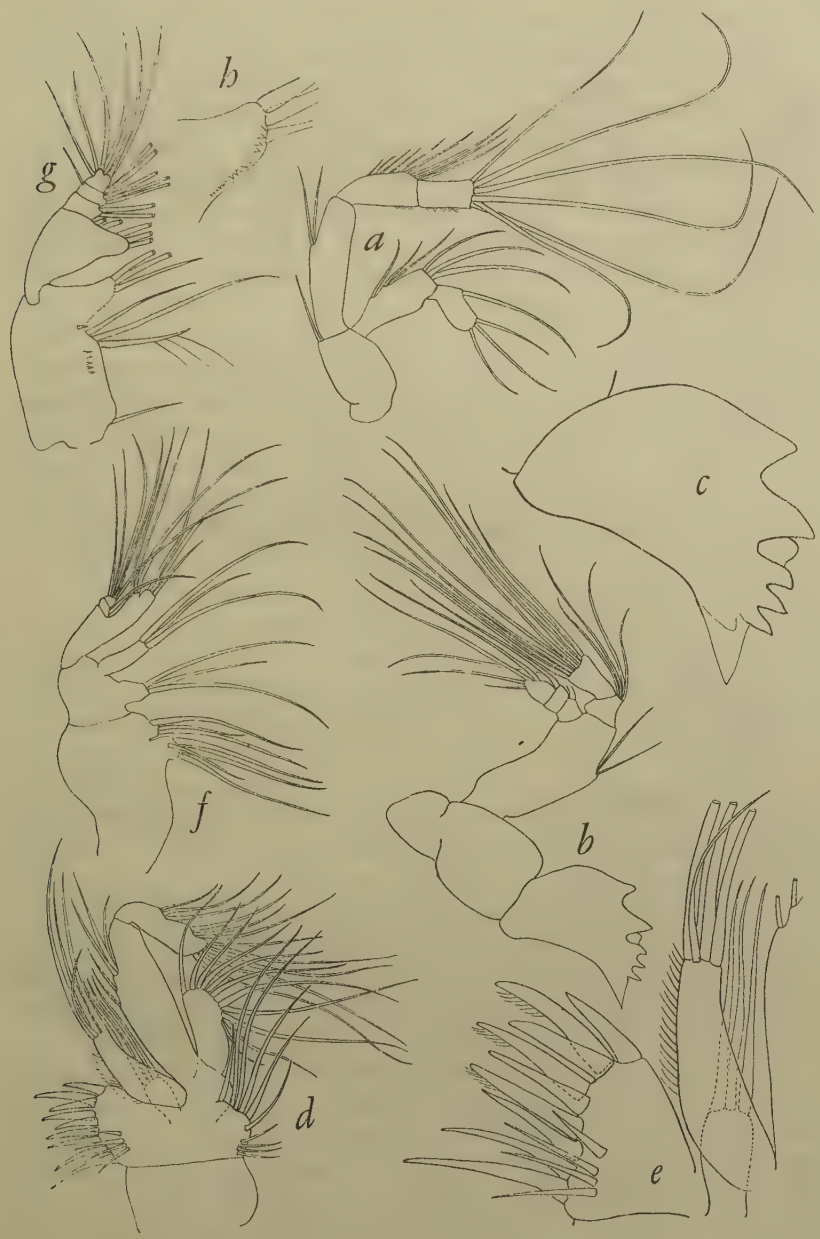

FIGURE 7.—*Pseudocyclops rostratus*, new species, female: *a*, Antenna 2; *b*, mandible; *c*, mandible, gnathal lobe; *d*, maxilla 1; *e*, maxilla 1, inner lobes; *f*, maxilla 2; *g*, maxilliped; *h*; maxilliped, distal lobe of first segment.

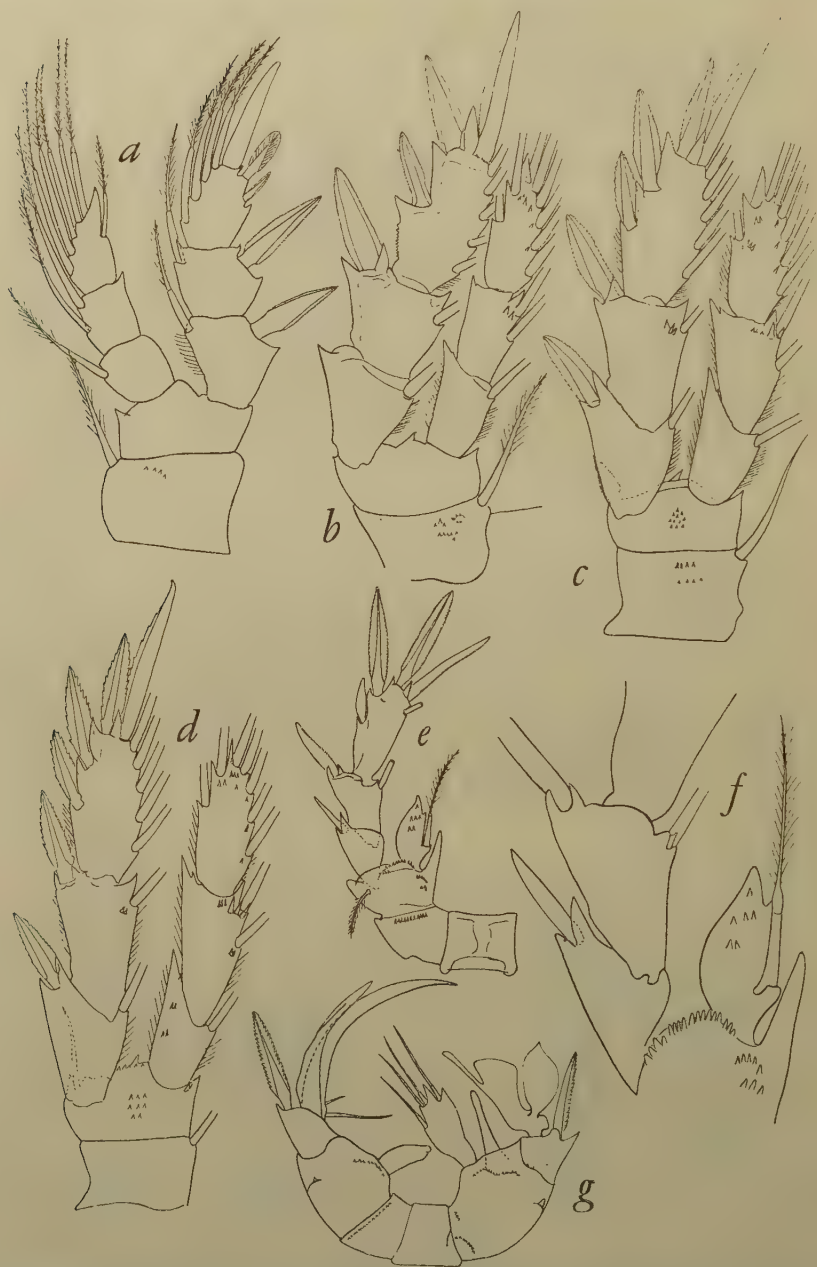

FIGURE 8.—*Pseudocyclops rostratus*, new species. *a–f*, Female: *a*, Leg 1; *b*, leg 2; *c*, leg 3; *d*, leg 4; *e*, leg 5; *f*, leg 5, detail. *g*, Male, leg 5.

posteriorly. Posterior lateral corner of second pedigerous segment produced posteriorly into curved, acutely pointed process. Third pedigerous segment with median dorsal line of sclerotization.

Urosome about three-tenths as long as prosome; posterior margins of segments serrate; serrations coarsest on median dorsal part of third segment. Caudal rami about a fifth longer than wide, without hairs on inner margins. Next-to-innermost caudal seta with short hairs on both margins of proximal part. Proximal part of second-from-innermost seta with short hairs on inner margin and barbs on outer margin.

Antenna 1 reaching nearly to margin of first pedigerous segment, composed of 16 segments. Antenna 2 with 1 seta on basipod; exopod 3-segmented; setation as shown in figure 7*a*. Basipod of mandibular palp with 2 setae; endopod segment 1 with 4 setae. Maxilla 1 with 5 setae on second basal segment; endopod with 2 groups of 3 setae on medial margin; exopod with 11 setae. Basal segment of maxilliped with 2 rows of surface spinules, 1 proximal to middle group of 3 setae, the others slightly set in from proximal margin of distal lobe.

Exopod segment 2 of leg 1 produced at outer distal corner into medially curved hook; distal outer seta of exopod segment 3 longer than proximal outer seta. Leg 1 with a few spinules on first basipod. Legs 2–4 with patterns of surface spinules shown in figure 8*b–d*; exopod segment 2 and proximal part of segment 3 of leg 2 with serrate outer margins; distal margins of exopod and endopod segment 1 of leg 3 finely serrate.

Connecting piece of leg 5 with nearly straight distal margin. Exopod segments 1 and 2 with stout outer setae; segments 2 and 3 with 1 inner seta. Endopod unisegmental, pyriform, bearing 3 rows of surface spinules; medial margin with small subterminal notch and larger setiferous notch at about a third the distance from proximal end. First basipod bearing a row of spinules parallel with and just proximal to distal margin. Second basipod with rounded bulge bearing row of spinules; medial distal corner produced into ensiform process slightly more than half the length of endopod.

Male: More slender than female; total length about 0.72 mm. Rostrum as large as in female, not articulated. Caudal setae as in female. Right antenna 1 17-segmented; anterior margin of antepenultimate segment produced distally into triangular process; segment 14 with heavy spine. Right first basipod of leg 5 with row of surface spinules near distal margin. Right second basipod with curved row of spinules near origin of endopod. Right endopod more than twice as long as wide, notched near apex. Left second basipod with several rows of surface spinules. Inner membranous lobe of left exopod segment 2 trapezoidal, with slender linear process on inner margin; outer

lobe oblanceolate, with acuminate apex. Left endopod bearing 4 setae, medial setae arising proximally to others; produced at apex into median tooth and shorter outer tooth. Modified seta adjacent to endopod linear, moderately robust.

Color: Body transparent, with some internal brick-red blotches.

Types: Holotype, female, USNM 104379; allotype male, USNM 104380; and 3 paratypes (2 females, 1 male), from *Thalassia* meadow, Canal de Magüeyes, La Parguera, Puerto Rico, collected June 9, 1959 (holotype) and Nov. 25, 1959 (allotype and paratypes).

The specific name rostratus (Latin "rostratus," meaning beaked) refers to the large, conspicuous rostrum.

The remarkably large rostrum distinguishes *P. rostratus* from all other species of *Pseudocyclops*. The rostrum is also strongly developed in the much smaller *P. paulus*, but not nearly to the degree that it is in *P. rostratus*. The acute posterior lateral corner of the second pedigerous segment is also useful for recognition, and the fifth legs of both sexes are unlike those of any other species.

Pseudocyclops rubrocinctus, new species

Figures 9*a-f*, 10–11

Female: Length, excluding caudal setae, 0.55–0.62 mm. Prosome, viewed dorsally, about twice as long as wide. Head separated from first pedigerous segment. Rostrum strong. Median sclerotization of third pedigerous segment present, but much shorter than in *P. paulus*. Fifth pedigerous segment with a few minute setae near posterior margin.

Urosome about a third as long as prosome (urosome may be proportionately shorter in specimens in which the segments are contracted); posterior margins of segments minutely serrate. Genital openings with conspicuous sclerotization. Caudal rami about a sixth longer than wide, without hairs on inner margins. Next-to-innermost seta thicker and longer than others; proximal part with barbs on both margins, those on lateral margin more numerous. Proximal part of second-from-innermost seta with similar barbs on lateral margin; more numerous, longer, and more slender barbs on medial margin.

Antenna 1 reaching middle of first pedigerous segment, composed of 18 segments. Antenna 2 with 2 seta on basipod; exopod apparently 3-segmented, setation as shown in figure 11*a*; endopod with minor differences in setation from that of *P. cokeri*. Gnathal lobe of mandible with more teeth than that of *P. cokeri*; basipod of palp with 2 setae; endopod segment 1 with 4 setae. Maxilla 1 with 4 setae on second basal segment; endopod with groups of 3 and 4 setae on medial

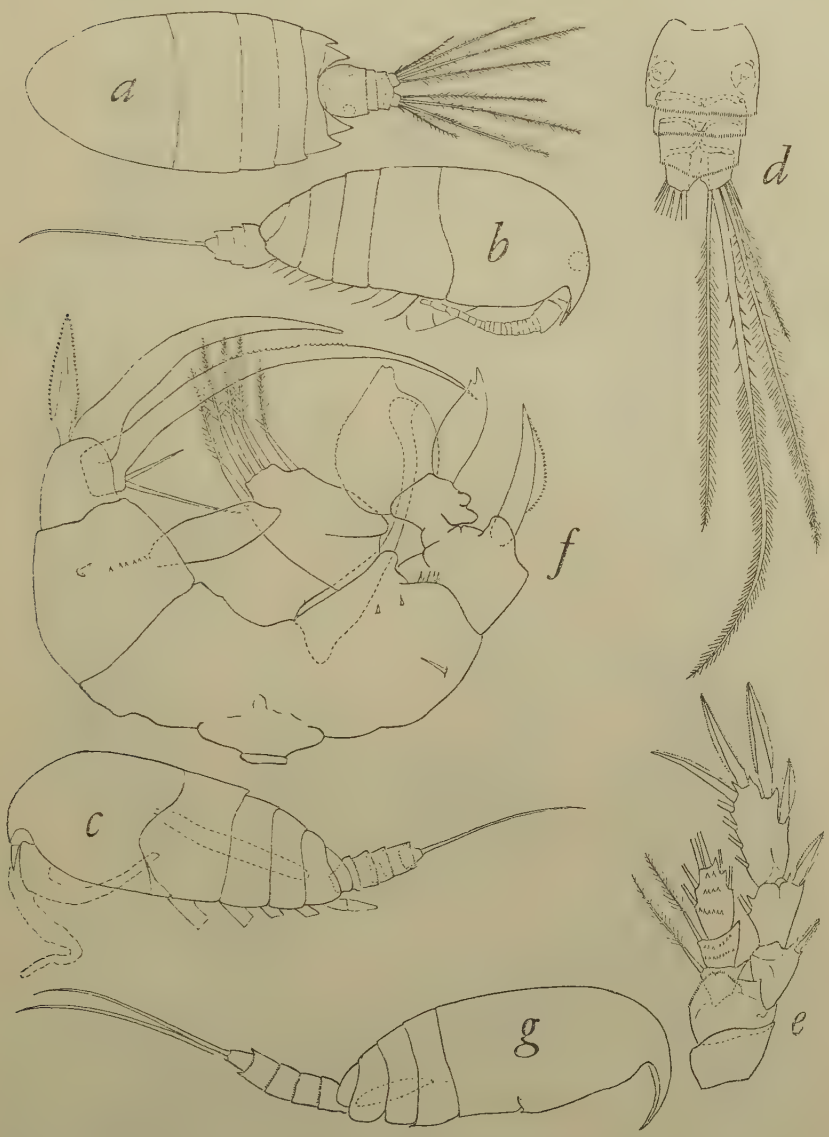

FIGURE 9.—*a–f*, *Pseudocyclops rubrocinctus*, new species: *a*, Female, dorsal; *b*, female, lateral; *c*, male, lateral, *d*, urosome, female, dorsal; *e*, leg 5, female; *f*, leg 5, male. *g*, *Pseudocyclops rostratus*, new species, male, lateral.

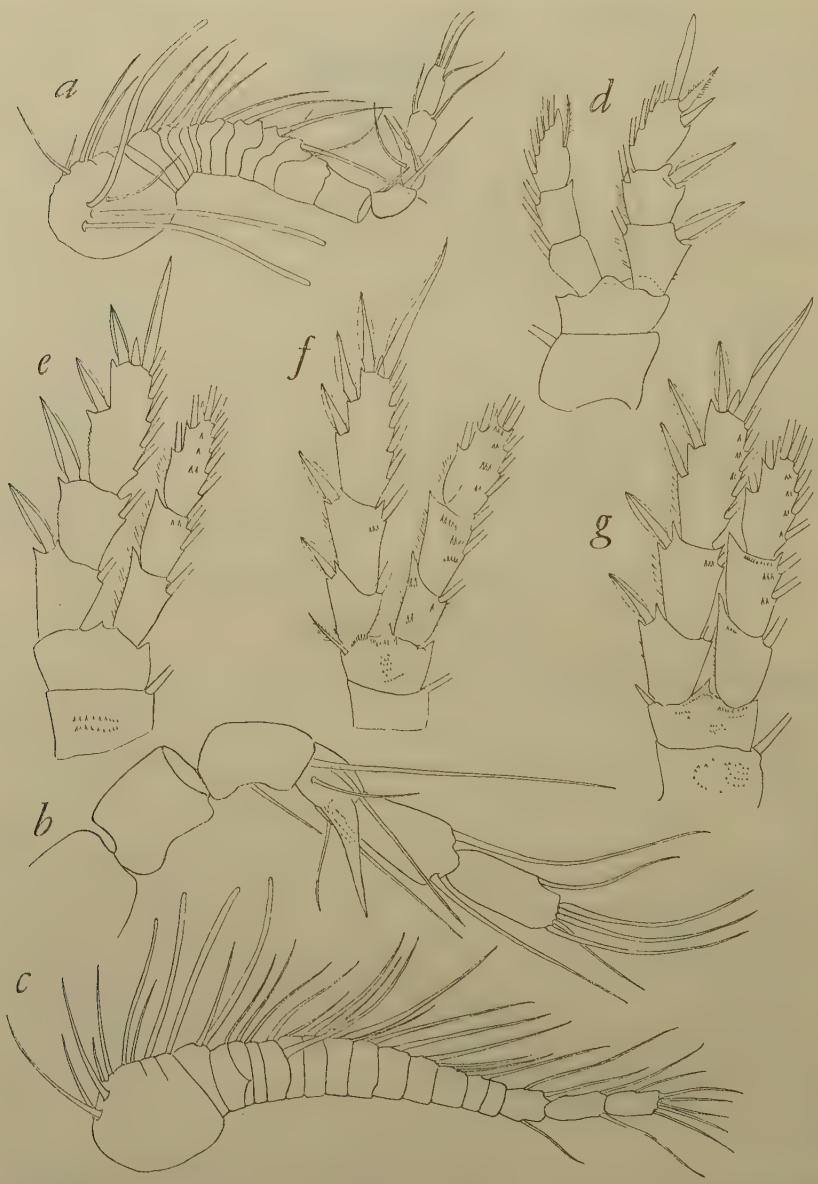

FIGURE 10.—*Pseudocyclops rubrocinctus*, new species. *a–b*, Male: *a*, Antenna 1; *b*, antenna 1, distal segments. *c–g*, Female: *c*, Antenna 1; *d*, leg 1; *e*, leg 2; *f*, leg 3; *g*, leg 4.

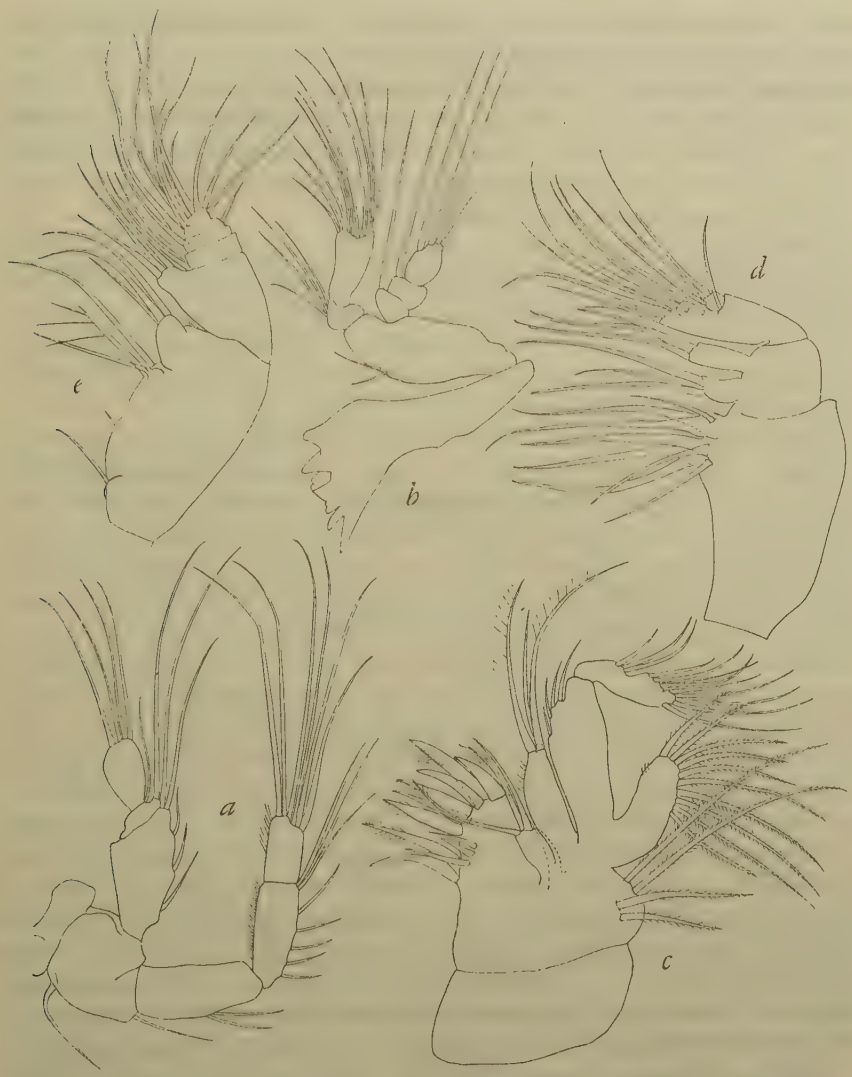

FIGURE 11.—*Pseudocyclops rubrocinctus*, new species, female: *a*, Antenna 2; *b*, mandible; *c*, maxilla 1; *d*, maxilla 2; *e*, maxilliped.

margin; exopod with 10 setae. Maxilla 2 and maxilliped with more setae on terminal portion than in *P. cokeri*.

Exopod segment 2 of leg 1 produced at outer distal corner into rounded bulge; distal outer seta of exopod segment 3 slightly longer than proximal outer seta. Legs 2–4 with patterns of surface spinules shown in figure 10*e–g*; exopod segment 2 and proximal part of segment 3 of leg 2 with serrate outer margins.

Connecting piece of leg 5 with nearly straight distal margin. Exopod segments 1 and 2 with stout outer setae; segment 2 with inner seta; segment 3 with 4 inner setae. Endopod 3-segmented; segment 2 with 2 rows, segment 3 with 2–3 rows of surface spinules; segment 3 with 6 setae. Second basipod produced medially into rounded bulge with serrulate distal margin.

Male: Smaller and more slender than female, total length about 0.50 mm. Rostrum articulated at base. Caudal setae as in female. Antenna 1, 17-segmented; antepenultimate segment produced into narrow triangular process. Right second basipod of leg 5 with row of surface spinules at level of origin of endopod. Longer inner spine of right exopod minutely serrate along middle third of convex outer margin. Right endopod more than 3 times as long as wide, apex emarginate. Left second basipod with row of spinules on distal margin. Inner membranous lobe of left exopod segment 2 broadly pyriform, middle part of inner margin crenulate; outer lobe much narrower, apex divided by V-shaped notch. Left endopod produced into lobe laterally near base, distal end bearing 5 jointed setae of which medial and lateral ones arise proximally to 3 central setae.

Color: Typical specimens have a band of red pigment encircling the middle part of the prosome, extending ventrally from the base of the first maxilla to the base of the second swimming leg. The band is slightly wider dorsally. The eye is orange red. In some females the pigment may be more extensive, coloring most of the prosome or even the entire body. In some of the latter specimens the pigment is heavier in the region with the band of pigment in typical specimens.

Types: Holotype, female, USNM 104382; allotype, male, USNM 104383; and 2 lots of paratypes (52 females and 7 females); from *Thalassia* meadow, Canal de Magüeyes, La Parguera, Puerto Rico, collected Mar. 25, 1959 (holotype), Nov. 25, 1959 (allotype and 7 paratypes), and Feb. 23, 1959 (52 paratypes).

The specific name *rubrocinctus* (Latin "ruber", red, and "cinctus," girdled) refers to the red band of pigment of the prosome.

The incompletely described *P. reductus* Nicholls (1944) from the Red Sea (Ghardaqa) appears to be very close to *P. rubrocinctus*. The female fifth legs of the 2 species are very similar, but endopod segment 3 of *P. reductus* has only 4 setae, while that of *P. rubrocinctus* has

6. Exopod segment 3 of *P. reductus* has but 1 inner seta, while 4 are present in *P. rubrocinctus*. The arrangement and number of barbs on the caudal setae differs somewhat in the 2 species, and other differences are evident in antennae 1 and 2. The male of *P. reductus* has not been described.

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